June 25, 2010

Mr. Tony Daniels
Parsons Brinckerhoff
303 Second Street
Suite 700 North
San Francisco, CA 94107-1317

Re: Institute of Transportation Studies June 15, 2010 Draft Report

Dear Mr. Daniels:

Thank you for the opportunity to review and comment on the Institute of Transportation Studies' Draft Report (ITS Draft Report) entitled *Review of "Bay Area/California High-Speed Rail Ridership and Revenue Forecasting Study: Interregional Model System Development Final Report*."

Cambridge Systematics, Inc. (CS) appreciates the authors' acknowledgment in the report that our model development team "followed generally accepted professional standards in carrying out the demand modeling and analysis."

Since its founding in 1972, CS has been at the forefront of professional practice for developing, validating and applying travel demand models for use at the local, regional, state and national levels. We have also developed courses on advanced travel demand forecasting techniques, survey data collection and travel model validation for the Federal Highway Administration. A few examples of the statewide models developed by CS include models for Indiana, Massachusetts, Florida, Wisconsin, New Mexico, New Hampshire, Georgia, and California. Our experience also includes the development of inter-regional models for the Colonia Bridge linking Argentina and Uruguay, and for the Illiana corridor linking Illinois and Indiana. CS developed a national model in Italy and applied it to estimate high speed rail forecasts for the Torino-Milano-Napoli corridor proposed for TVA (Treno Alta Velocita). In addition to its work for the California High-Speed Rail Authority (the Authority), CS also studied the potential of high speed rail corridors proposed in Florida, the corridor linking Boston and Albany, and the corridor between Boston and Montreal. CS staff have also participated in the earlier high speed rail study for the Texas Triangle, a study of the economic benefits of high speed rail for the Northeast corridor, and the determinants of demand for airline travel.

As noted in the ITS Draft Report, we relied on the expert experience and judgment of our CS modeling staff, our teaming partners, the peer review team, and the client's project manager (Chuck Purvis, formerly with the Metropolitan Transportation Commission, and widely regarded as one of the foremost authorities on travel demand forecasting practice in the United States). A good model development effort relies on the collective experience and judgment of the project team in order to properly apply theory so that the resulting model meets its intended objectives. We did that.

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Except for the authors' acknowledgment that the CS team followed generally accepted professional standards, we find the ITS Draft Report deficient in significant, substantive ways, and we emphatically disagree with the authors' conclusions that the model is not reliable.

The ITS Draft Report focuses on academic viewpoints and ignores what it takes to create a model for real-world application. We also conclude, as indicated by the title of the ITS Draft Report and the its content, that the authors based their arguments substantially on a review of one document without considering the many other reports and model files in the substantial project record that were provided to them. Of even more concern is the fact that the ITS Draft Report is filled with qualifications to the authors' statements, such as "appears that," "is likely that," and "implies that," yet on the basis of these statements the authors draw very definitive conclusions. The authors repeatedly state that the model contains "biases" and "inconsistencies" without further detail. They simply jump to the unfounded conclusion that the resulting model is unreliable.

In summary, in reaching a conclusion of "bias and inconsistency" in model results, the authors misunderstand how we developed the model, rely on generalizations without the experiential understanding that comes from being engaged in the model development process, and make categorical pronouncements about model results without documenting any analytical foundation.

As to the specific arguments presented in the ITS Draft Report, our more detailed responses that follow will show that, contrary to the authors' conclusions:

- The database developed in support of model development **is** representative of the traveler population;

- The methodology we employed to adjust model parameters was correct when we developed the model and remains standard practice today;

- We did not change key parameters to accord with our a priori expectations; rather, the final values for key parameters are based on empirical evidence;

- The calibrated value for the headway variable does not make the predicted shares of the travel modes overly sensitive to changes in frequency;

- The model properly accounted for a traveler's station choice options, and provides an appropriate comparison of ridership between the Altamont and Pacheco routes; and,

- Sensitivity tests show that the model performs consistently with changes in input variables and that ridership forecasts fall within reasonable bounds based on comparisons to prior forecasting work and worldwide HSR ridership experience.

We appreciate and respect the fact that individuals can disagree on elements of model development. Such differences of opinion are inevitable when developing a model. It is our contention that the broad arguments the reviewers make regarding the impact of elements about which they have a differing opinion do not bear out their conclusions. Even if we were to concede points they have made about elements of the model, and we do not, the impact on results would be immaterial to the ridership forecasts.

Contrary to the conclusions reached by the authors of the ITS Draft Report, the HSR ridership and revenue model does produce results that can inform the Authority's decisions about HSR in California, including reasonable estimates of overall ridership levels to support environmental impact analysis and decisions on service areas and system alignment. This response to the ITS Draft Report, including details on subsequent pages, along with our responses to their earlier questions presents the reasons for our confidence in this state-of-the-practice model.

CS stands firmly behind the travel demand model our experts have created.

Sincerely,

CAMBRIDGE SYSTEMATICS, INC.

Lance A. Neumann

Lance A. Neumann
President

LAN/cjf/7946-013

Detailed Response to ITS Draft Report

The following pages provide our responses to the specific criticisms made by the reviewers in the ITS Draft Report.

Issue 1. Arbitrary Division of Trips into Long and Short Trips

The ITS Draft Report claims that the adopted convention of developing separate models for short-distance (less than 100 miles) and long-distance (100 miles or more) "causes problems". We disagree with the reviewers' conclusion.

We followed a widely accepted and proven market segmentation approach of stratifying the trips, in this case, into short and long trips. During the model design phase, the decision was made to distinguish between shorter and longer trips using an approach that has been used in the past in the design of the American Travel Survey and the National Household Travel Survey. In short, stratification of trips into short-distance and long-distance trips is standard modeling practice and does not "cause problems" in model application.

As noted in our original response to the authors' questions, the distance coefficient cannot be studied in isolation from other explanatory variables. The reviewers acknowledged that travel time enters the model through the logsum variable (and, implicitly, that travel time also impacts distribution), but they stop there. Many other components enter through the logsum, including travel cost, reliability, frequency of service for nonauto modes as well as modeled traveler characteristics. In addition, other zonal characteristics, such as area type of the destination and interchange variables, are considered in the destination choice models.

Market segmentation is commonly used in the development of travel models. For example, market segmentation based on discrete variables such as households by size, households by autos owned, or number of workers is easy and straightforward, and is common in trip generation in urban models.

Market segmentation also is a commonly used practice for continuous variables. Perhaps the most widely known example is income level. Household income is a continuous variable but households are frequently stratified by income quartile or other groupings for modeling purposes.

Issue 2. Assigning all Business Trips to the Peak Period

The ITS Draft Report claims that the use of peak period service levels for all business/commute travel is "potentially a serious problem" for an interregional travel demand model. We disagree with this conclusion. In fact, this approach is reasonable and acceptable for both regional and interregional modeling.

The reviewers acknowledge that it is standard practice in model development to assign business and commute trips during the peak period. This convention simply reflects the fact that the majority of business travelers and commuters travel during the peak period and face peak-period levels of service. This pattern holds both for regional and interregional travel as the reviewers note. Therefore, using peak-period travel impedances for the business and commute travel market is a reasonable approach for a planning-level model for interregional travel.

Issue 3. Incorrect Treatment of the Panel Data Set in the Main Mode Choice Model

The ITS Draft Report states that "[i]t appears that Cambridge Systematics treated each SP response as independent and thus ignored likely serial correlation". According to the reviewers, such treatment may lead to "inflated t-statistics". Nonetheless, the reviewers conclude that "the parameter estimates are still consistent." We do not agree that the serial correlation presents an issue particularly given the reviewers' acknowledgement that "parameter estimates are still consistent". The resulting model coefficients are consistent and their relative values are correctly estimated.

Each respondent received only four stated preference choice experiments and this approach was used consistently across all market segments. Furthermore, serial correlation does not affect the relative values of the coefficients or the final model results. Moreover, the stated preference survey design and model estimation was led by one of the pioneers in the use of stated preference data for travel model estimation, Mark Bradley. He literally "wrote the book" on how to collect and use such data, and has been doing so in practice for over 20 years.

The implication of the reviewers' comment is that it is possible that some model coefficients appear to be more "statistically significant" than they should be. Even if this were the case, the coefficient values would not change. Therefore, this issue has no effect on the final models.

Issue 4. Constraining the Headway Coefficient

The ITS Draft Report notes that the relative relationship between the coefficients for headway and in-vehicle travel time (IVTT), was different during initial model estimation than during model calibration. The reviewers contend that constraining this coefficient led to "bias in the model forecast" because the headways for interregional service are much longer than for urban travel, resulting in different arrival patterns for travelers at HSR stations compared to urban transit systems. We disagree with the assertion that planned headways for California HSR are substantially different than for urban rail service. Accordingly, we believe that the treatment of sensitivity to wait times and headway is reasonable and does not introduce any biases.

The frequency of air and rail service has an impact on the time that travelers expect to wait at a terminal or a station, and on the convenience with which they are able to travel close to their

desired departure time. Therefore, two separate components are used to reflect the impact of service frequency on travelers' choice behavior.

Based on observed data and expert input, average wait times of 55 minutes were established for air travelers and 15 minutes for HSR and rail travelers. Similarly, separate terminal processing times of 18 to 24 minutes were established for air travelers and 3 to 12 minutes for HSR and rail travelers. The sensitivity to wait and terminal time is twice as high as the sensitivity to travel time, consistent with the literature and practice.

Beyond this traditional "wait-time" component, the sensitivity to headways was introduced as an additional component to reflect travelers' anticipated reaction to schedule convenience.

The proposed HSR service offers a new paradigm of interregional service. The proposed HSR headways are more comparable to the best urban rail services in the U.S. rather than current intercity air and passenger rail services. In this context, the value that was used for the headway coefficient was debated during the model estimation and validation process, and a value consistent with urban rail systems was determined to be appropriate given the planned frequencies of the California HSR system.

During calibration of the original model, there was an overestimation of air trips in markets with low frequency of air service and an underestimation of air trips in markets with high-frequency air service. The merits of different potential interpretations and values for the headway coefficient were documented and discussed during the peer review process. The constraint on the coefficient was deemed to be a more reasonable approach than introducing higher alternative-specific constants that would have a greater impact on model sensitivity.

Finally, it also should be noted that the short headways and corresponding short wait times account for a small portion of the interregional air and high-speed rail travel times in this study. As a result, the impact of using different assumptions on coefficient values will be correspondingly small.

Issue 5. Absence of an Airport/Station-Choice Model

The ITS Draft Report contends that the adopted process for assigning travelers to individual airports and rail stations is "behaviorally unrealistic". The reviewers contend that the absence of a more elaborate modeling structure for airport/station choice "has a substantive impact on the comparisons of ridership for the Altamont and Pacheco corridors." We disagree with both points. Further, we believe that a more elaborate "airport/station choice model" is not critical for meeting the objectives of the model development and application work that has been conducted, nor for accurately distinguishing the ridership and revenue potential between the Altamont and Pacheco corridors.

The model currently uses a network-based method that assigns an airport or rail station to all travelers originating from a specific zone. The rule that is used is based on evaluating paths

from each origin zone to alternative airports and rail stations. The attractiveness of each path reflects the access modes that are available, the level of access service they offer, and the frequency of air and rail service available at each airport and rail station.

An airport/station-choice model would allow the allocation of a proportion of travelers to different nearby airports and rail stations. However, such an approach would have, at most, a minimal effect on Altamont's ridership, and then only for a few zones in the study area.[1]

We are providing an example to demonstrate the minimal effect that station choice would have for the base Altamont alignment (with split service between San Francisco and San Jose). Figure 1 shows a map of the central Bay Area with an overlay of the base Altamont alignment.

The primary East Bay stations at Livermore and Bernal/I-680 do not experience split service in the base Altamont alignment. Therefore, residents of Alameda, Contra Costa, and Solano Counties, which comprise the primary catchment areas for the East Bay stations, have full HSR frequencies and would experience no ridership gain from including a station-choice model.

Residents of Napa, Sonoma, Marin, San Francisco, and northern San Mateo Counties (north of Redwood City) would use an HSR station in San Francisco or along the Peninsula. Given the headways that are planned for the HSR system, even with split operations in the base Altamont alignment, it would be completely illogical for a resident of, say, San Mateo to pass up the nearby Redwood City HSR station and drive 25 miles further south to San Jose (or 30 miles east to Bernal/I-680). For residents of these five counties, a station-choice model would not increase ridership from these areas.

A similar situation holds for many residents of Santa Clara County. Essentially, travelers residing in areas east of Sunnyvale are going to use either a San Jose or Warm Springs station given the HSR headways that are planned. Therefore, a station-choice model would not increase ridership from the majority of Santa Clara County.

We are left with a small portion of the Bay Area between roughly Atherton and Sunnyvale that *might* achieve some small measure of ridership gain from inclusion of a station-choice model; this area is shown in blue cross-hatch in Figure 1. The ridership and revenue forecasts for the base Altamont alignment projected 555,000 annual HSR trips from this geographic area. Even in the very unlikely event that inclusion of a station-choice model would double the number of HSR trips from these communities, that would less than 0.6 percent of total projected ridership of 87.9 million for the base Altamont alignment. This level of change is inconsequential.

In summary, we disagree with the conclusion drawn, and believe that a station access model would potentially impact the results in only a small portion of the study area.

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[1] A station-choice model would have no practical effect on overall ridership projections for the base Pacheco alignment since it has a single alignment through the Bay Area.

Figure 1 – Base Altamont Alignment

Issue 6. Calibration of the Alternative-Specific Constants

The ITS Draft Report is critical of the procedures followed for calibrating mode specific constants from choice-based sampling, and claims that these procedures were reportedly found to be "wrong" in a paper written by Bierlaire in 2008, after development of the model between 2005 and 2007. We do not agree with the statement made by the reviewers that the referenced paper is the definitive source on this question. We relied on widely accepted practice at the time, the approach we followed continues to be standard and accepted practice, and the procedure referenced by the review team from the Bierlaire paper has not become accepted practice.

In our view, this point of criticism reflects an example of a classic academic debate that will go on for some time. As with most academic work that breaks new conceptual and analytical ground, the theoretical debate will continue before reaching a consensus which will eventually translate the insights from the new theory into accepted practice.

Choice-based sampling offers a proven, efficient method to collect surveys from key market segments of interest such as current air passengers and rail riders. A long-established and widely accepted procedure has been used to calibrate the alternative-specific constants to account for the impact of choice-based sampling. With the exception of the alternative-specific constants that need to be adjusted, the coefficients of the explanatory policy-sensitive variables are unbiased and consistent.

Consequently, we disagree with the argument that the method used to adjust the alternative-specific constants resulted in biased and inconsistent model parameters.

Issue 7. Excessive Constraining of Coefficients

There is not "excessive constraining of coefficients in the final models."

To address this issue, we need to distinguish between the necessary adjustments made to modal and regional constants during model validation versus the few constraints that we imposed on explanatory variables during model estimation.

The rationale to constrain selected model coefficients reflects cases where empirical results from survey-based model estimation do not agree with other sources of empirical data. These data sources include observed air and rail ridership and market shares, interregional or local travel flows, or highway traffic counts. Contrary to the reviewers' suggestion of the existence of clear and straightforward "empirical evidence," model estimation results are often in conflict with the other sources of empirical data. We did not override a body of overwhelming empirical evidence but exercised reasonable professional judgment to rectify conflicts from different data sources.

During model validation we made adjustments to one set of modal constants and one set of regional constants. First, the modal constants were constrained during model validation to adjust for choice-based sampling and to reflect the existing market shares by each mode. Second, the airport-to-airport regional constants were used to more accurately reflect the inter-regional flows from air travelers, a key market segment for this study.

There were only a few selected instances in the main mode choice models where constraints were considered and implemented for a few explanatory variables:[2]

- In the long-distance models, there are 13 coefficients in the business/commute model and 11 coefficients in the recreational/other model that reflect policy-sensitive explanatory variables. Only 2 out of the 24 coefficients were constrained, including the headway coefficient (already discussed under item 4) and the reliability coefficient.

- In the case of the short-distance market, a market that is less important to high-speed rail ridership, a total of only 7 coefficients were constrained out of a total of 25 coefficients for policy-sensitive explanatory variables.

In summary, we believe that the extent of constraining has been very modest. In the few cases where we faced the dilemma of whether to accept the model estimation results, we used judgment very selectively to develop a more credible and reliable model using other sources of empirical evidence and accepted practice. At no point was constraining undertaken to match "modeler's beliefs" as stated by the reviewers.

[2] In our June 8, 2010 memorandum to Samer Madanat, we discussed in detail our rationale for constraining the headway and the reliability coefficients in the long-distance models and for imposing a few constraints in the short distance models.